

MINOR (J.L.) Dr B. Joy Jeffries

THE FIELD OF VISION.

BY

for JAMES L. MINOR, M. D.,

PATHOLOGIST AND ASSISTANT SURGEON TO THE NEW YORK EYE AND EAR INFIRMARY.



FROM
THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES.
JULY, 1883.

THE FIELD OF VISION.

By JAMES L. MINOR, M.D.,

PATHOLOGIST AND ASSISTANT SURGEON TO THE NEW YORK EYE AND EAR INFIRMARY.



It is well known that, when the eye is fixed upon a stationary object, we see clearly only that part looked directly at; while surrounding zones are seen with increasing indistinctness as we pass from the point of fixation to the periphery of the view, until a point is reached where everything fades from our sight. The area thus obtained with a single eye is the *field of vision*, which is a map of the visual power of the entire retina, from the macula lutea to the ora serrata. The visual field (which we will designate V. F.) furnishing, as it does, a reflected (inverted) image of the perceptive power of the whole eye, is interesting in health and important in disease; for we here have to deal with an organ intimately connected, both anatomically and physiologically, with the brain, that participates with many, if not most, of the pathological processes affecting the latter, and shows such participation in a clear and demonstrable manner. Various methods have been resorted to for mapping out the V. F. in such form as to admit of its being recorded on paper for permanent preservation. The fundamental principle is to have the eye under examination fixed upon a stationary point in front of it, while a movable object establishes the extreme limit of visual perception for the various meridians of the eye, thus mapping out the boundary of the V. F. A rough but convenient way is to have the patient look at the tip of one of the examiner's fingers, held 12" in front of the eye, while, with a finger of the other hand, the peripheral limit of the V. F. is established. A still better method is to have the patient look at a small spot on a blackboard, 12" from the eye, while the V. F. is mapped out by a bit of white paper 1" sq. in a holder, and recorded with chalk on the blackboard, whence it can be transferred to paper. Both of these methods are objectionable. The first is too rough and inaccurate, and the second presents difficulties that it is hard or impossible to overcome. The blackboard is a plane surface; hence the peripheral test object, as it is carried from the point of fixation, will also be removed from the eye, so that it will often be necessary to increase the size of the test object to make it visible at so great a distance as it is necessary to place it. And, again, the limit of the V. F. in many eyes reaches

a point 90° from the centre of fixation; thus forming a right angle with the visual axis, which would bring about parallelism between the black-board and the limit of the V. F. in this locality.

The only reliable method of taking the V. F. is with a *perimeter*, and of these there are many varieties to choose from. The essential part of a perimeter is an arc of a circle, 180° in extent, and preferably of $12''$ radius, pivoted at its centre to an upright, which allows it to be turned to the different meridians desired. Beginning at the centre with 0° , each limb of the semicircle is marked off in degrees, up to 90° , at its end. A chin-rest is important, and it is convenient to have on the rear of the arc a stationary disk, with a series of radii, going around from 0° to 360° , with an indicator which moves with the arc, to show the meridian occupied by the arc in any given position. Such an instrument has been made for me by Mr. Schrauer of this city. It combines all of the requirements of a perfect perimeter with simplicity and cheapness.¹ A glance at the cut will render further description unnecessary. (See Fig. 1.)

To take the V. F., the patient places his chin on the chin-rest, and looks with the eye to be examined (the other eye being covered) at the small spot on the centre of the arc. A piece of white paper, $1''$ sq. in a simple holder, is moved from the periphery of the arc towards the centre, and the point at which it is first seen is noted. This is done with each limb of the semicircle in the desired meridian, usually six, and these measurements are recorded on a chart made for the purpose, which is laid out in radii and circles that are numbered so as to correspond to the perimetric measurements. (See Fig. 2.)

The normal central acuity of vision is in marked contrast with that in the periphery of the V. F. At $12''$ from the eye an area in the V. F. $\frac{1}{3}''$ by $\frac{1}{4}''$ would include that portion possessed of normal (central) vision. Within this space the normal eye can distinguish an object which subtends an angle of one minute upon the retina. An object subtending an angle of this extent, having been taken as the unit of visual acuity, it becomes an easy matter to measure the amount of reduction in sight when it is below the normal, by comparing the extent of the angle formed by the test-object used with that which is taken as the normal standard, *i. e.*, one minute. The size of the object (measured by the angle that it forms on the retina) will increase as the visual acuity diminishes.

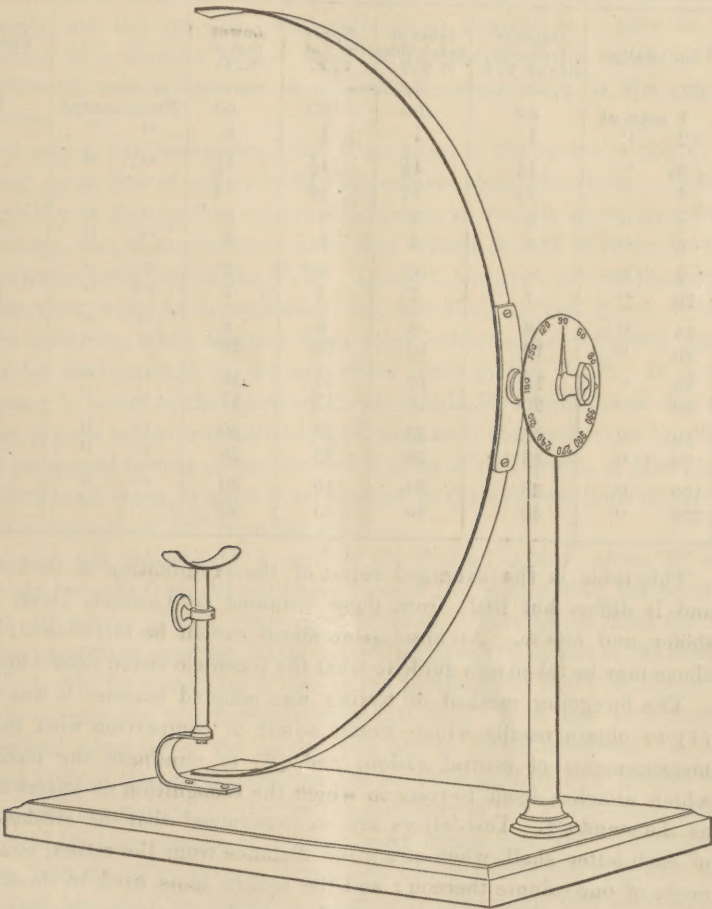
For testing the acuity of vision in eccentric portions of the V. F., I used slips of white paper, on each of which were drawn three black square spots, the space between each spot being equal to the diameter of the spots which it separated. Each spot was of such size as would subtend an angle of one minute upon the retina; when viewed at the distance in feet, indicated by the number on the slip,² *e. g.*, No. 1, one foot from the

¹ A simplification of Forster's instrument.

² These squares represent cross-sections of the limbs of Snellen's test-letters.

eye would subtend an angle of one minute; No. 2 an angle of one minute at two feet; No. 100 at one hundred feet, etc. etc. Only normal eyes were examined. First, the limit of perception was mapped out, and this gave the *quantitative field*. Next, the *qualitative field*, or that portion of V. F. possessed of form perception, was determined in the following way: The slip of paper with spots which would subtend an angle of one minute,

Fig. 1.



when seen at a distance of two hundred feet, and marked 200, was slowly brought from the periphery of the arc of the perimeter towards the centre, and the point at which the spots were recognized as three separate dots was noted, and vision at that point was set down as $\frac{1}{200}$; for an object which, when in the centre of the V. F., could be seen at 200 feet, had to be brought to a point one foot from the eye before it was recognized in this

portion of the V. F. This was repeated for the various meridians, and thus the zone in the V. F., possessing vision of $\frac{1}{200}$, was determined. Then the next number, 100, was treated in the same manner, and the points at which its spots were recognized being noted, that portion of the V. F. possessing vision of $\frac{1}{100}$ was established. This was repeated for all of the different sized spots. The extent of each zone, in degrees upon the perimeter, is given in the following table :—

No. of slip.	Outer or temporal side of V. F.	Inner or nasal side of V. F.	Upper part of V. F.	Lower part of V. F.		Vision is
1 seen at	00	00	00	00	From centre	1
2 “	1	1	1	1	“ “	$\frac{1}{2}$
3 “	$1\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{1}{3}$	$1\frac{1}{3}$	“ “	$\frac{1}{3}$
4 “	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	“ “	$\frac{1}{4}$
5 “	3	3	3	3	“ “	$\frac{1}{5}$
6 “	4	4	5	4	“ “	$\frac{1}{6}$
8 “	6	6	6	6	“ “	$\frac{1}{8}$
10 “	7	7	7	7	“ “	$\frac{1}{10}$
15 “	8	8	8	8	“ “	$\frac{1}{15}$
20 “	10	10	10	10	“ “	$\frac{1}{20}$
30 “	15	15	15	15	“ “	$\frac{1}{30}$
40 “	20	18	17	17	“ “	$\frac{1}{40}$
50 “	25	23	20	20	“ “	$\frac{1}{50}$
70 “	33	28	25	25	“ “	$\frac{1}{70}$
100 “	38	34	30	30	“ “	$\frac{1}{100}$
200 “	50	40	35	40	“ “	$\frac{1}{200}$

This table is the averaged result of the examination of twelve eyes; and it differs but little from those obtained by Landolt, Dorr, Königshöfer, and others. An absolute standard cannot be established, but the above may be taken as a guide to what the eccentric vision should approach.

The foregoing method of testing was adopted because it was desired (1) to obtain results which would admit of comparison with the usual measurements of central vision, and (2) to eliminate the uncertainty which attaches itself to tests in which the recognition of letters is taken as the standard. Test-letters are so constructed that the stroke or limb of each letter shall, when at a given distance from the retina, subtend an angle of one minute thereon; and the square spots used in these experiments were sections of a single limb or stroke of the test-letters in most general use (Snellen). Thus, the tests for central and peripheral vision were made to practically correspond. And as a clear recognition of a letter requires that the stroke or strokes composing it shall be clearly seen, it is necessary that a large part of the V. F. be occupied by the letter; and this involves an association of retinal zones, possessed of different degrees of visual acuity, for the recognition of a single object, while the squares represent that part of the letter which is taken as the unit of its

measurement. Another advantage offered by the squares is that the accuracy of the tests can be verified by covering one or more of the spots during an examination of any zone. Certain variations will be found in the normal eye, dependent upon such conditions as differences in illumination, intelligence, and attention of the patient, and the amount of practice and education of the retina, as well as the patience of the examiner.

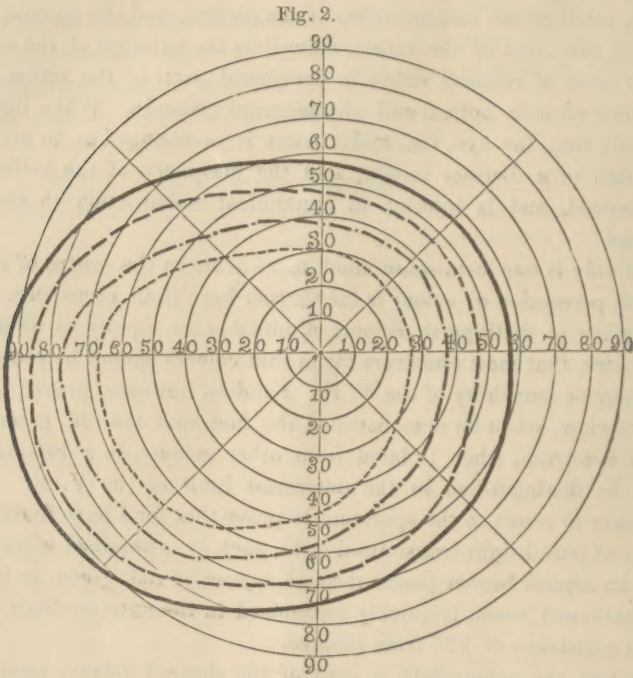
The cause of reduced vision in peripheral parts of the retina is to be explained on both optical and physiological grounds. When light passes obliquely into the eye, the nodal point is so changed as to prevent the formation of a distinct image; and the periphery of the retina is less experienced, and is inferior in anatomical construction to the central portions.

Not only is our form-sense much more acute in the centre of the V. F. but our perception of colour is far sharper here than elsewhere. Indeed our ability to distinguish colours diminishes so rapidly as we pass from the centre, that most observers claim that colours cannot be recognized in the extreme periphery of the V. F. Landolt, however, proved the falsity of this view, when he demonstrated the fact that the red, green, or blue of the spectrum, when isolated from other colours, in a darkened room, could be distinguished in the outermost limit of the V. F. It is not necessary to resort to the spectrum to prove this, for I have found that the colour of pure bright transmitted light, such as is obtained when the light from an argand burner passes through a piece of red, green, or blue glass, in a darkened room, is quickly recognized in the extreme limit of the V. F., at a distance of 12'' from the eye.

To test the colour-field, a card of the desired colour, about 1'' sq., is slowly brought from the periphery toward the centre, and the point at which its colour is first recognized is noted. This being done for the various meridians, and the points united, we have the extent of the colour-field. It will be found that a zone in the periphery of the V. F. exists, in which colours are not recognized by this test. It is due to a lack of purity and intensity of the colour, and not to colour-blindness. It will be also noticed that certain colours can be distinguished at a greater distance from the centre—further in the periphery of the V. F.—than others. The field for blue is most extensive; next comes red, and finally green. It has been stated by various Americans who have written upon this subject, that the field for green is more extensive than that for red; and some European writers have fallen into the same error. (See Fig. 2.)

Having studied with some detail the acuity of vision in the normal V. F., it may be of interest to glance at some of the affections in which peripheral vision is reduced or destroyed. It is hardly necessary to mention that lesions of the eye, involving destruction or loss of function of the retina, are accompanied by blindness in that part of the V. F. corresponding to the retinal lesion. Hence in many cases, and especially those in

which a satisfactory ophthalmoscopic examination cannot be made, the V. F. is of material assistance in deciding the extent or locality of an *injury* inflicted by, or the presence of, a foreign body in the globe; a



retinal detachment, intra-ocular tumours, or hemorrhages, and gross circumscribed pathological changes in the inner tunics of the eye. An embolism of one of the retinal vessels will be accompanied by blindness in that portion of the V. F. corresponding to its distribution. (The upper part of the V. F. corresponds to the lower portion of the retina, the temporal side of the V. F. to the nasal side of the retina, and so on for other parts.)

In *cataract* the functional activity of the retina, as tested by a candle, or better, by the reflected light from a mirror, throughout the V. F., is a question which may decide for or against an operation.

In a certain form of *retinitis (pigmentosa)* the concentric limitation of the V. F. is peculiar and characteristic. Cases of this disease are often seen with good and sometimes perfect central vision, while the V. F. is reduced to an area not exceeding 10° or 15° in extent.

In *glaucoma* the V. F. is contracted, and most frequently on the nasal side. Often it is this symptom that decides the diagnosis in a doubtful case.

In *hemianopsia* (blindness in one-half of the V. F.) we often gain important information as to the locality of the intra-cranial lesion upon which it depends, by a study of the V. F. The most frequent form is *homonymous* hemianopsia, or blindness of corresponding halves of each V. F. (the nasal of one and the temporal of the other), and in these cases the lesion will be on the opposite side of the brain, involving either the optic tract or the cerebral substance further back. *Crossed* hemianopsia presents two varieties—first, absence of the *temporal* half, and, second, absence of the *nasal* half, of each eye. In the first variety the lesion involves the chiasm, and in the second, which is very rare, the lesion is a double one, involving each side of the chiasm or the outer side of each nerve.

In *megrim*, or sick headache, there are often transient attacks of blindness, or interruptions in the V. F., sometimes of a zigzag form, which is likened to a line of fortification. The cause of these phenomema is probably ischæmia of the retina. They are sometimes seen without headache or other symptoms.

In *optic neuritis* interruptions in the V. F. are common. They may be peripheric or central. The latter are called *scotomata*, and they are usually indicative of less gravity than peripheral limitations, which are as a rule followed by atrophy of the nerve.

In *optic nerve atrophy* defects in the V. F. are frequently seen, and most often they begin with peripheral limitation on the temporal side. Irregularity, such as sinuosity of outline, or *scotomata*, are suggestive of an unfavourable prognosis.

Amblyopic affections usually present irregularities in the V. F. that aid us in forming a prognosis. It may be said in general terms, that cases with peripheral contraction are progressive, and that those with perfectly outlined fields, either remain stationary or improve.

A more careful examination as to the *amount of vision* in the various parts of the V. F., will probably enable us to diagnose our cases with more accuracy, and to speak with greater positiveness about the prognosis in cases which are embraced under the last three headings.

All that can at present be claimed for *colour defects* in the V. F., of pathological origin, is that they are of material assistance as an aid to diagnosis, and that they help us in rendering a prognosis, when taken in connection with the other conditions, that go toward making up the case in question. Peripheral limitation of the colour-field, or inability to distinguish certain or all colours, in a circumscribed area (colour scotoma) or throughout the entire V. F., is of frequent occurrence in optic neuritis, in optic nerve atrophy, and in amblyopia. And the same rules that govern defects in the ordinary V. F., apply to abnormal colour perception. *Red* is the colour that usually suffers first, and *green* usually coincidently or next, and finally *blue*.

A *central scotoma for red*, complete or partial, accompanied with more

or less marked intra-ocular appearances, is considered by many as being almost pathognomonic of *tobacco amblyopia*. In most of these cases alcohol will also have been used, and a low grade of optic neuritis can usually be detected.

Quinia, when given in large doses, sometimes causes narrowing of the V. F. and limitation of the colour-field or colour-blindness, and may cause total amaurosis.

The same effects are ascribed to *salicin*. The functions slowly return under the influence of time and proper treatment.

NEW YORK, December, 1882.

THE MEDICAL NEWS.

A National Weekly Medical Periodical, containing in the 28-32 Quarto Pages of each Number, more Reading Matter than any other Medical Weekly in America.

Uniting the scholarship of a weekly magazine with the energy of a daily newspaper, THE MEDICAL NEWS renders a service of especial value to the profession. As a magazine, it contains *Original Articles* and *Lectures* by the ablest writers and teachers of the day, and judicious *Excerpts* and *Translations* from the medical, pharmaceutical and scientific periodicals of the world, and numerous *Editorials* from the pens of a large and able Editorial Board. As a newspaper, it maintains a corps of reporters and correspondents, in all the medical centres of the globe, and receives by telegraph prompt and accurate reports of *Society Meetings* and other matters of immediate interest. It is thus enabled to present without loss of time in each issue, the advance of knowledge attained in the medical sciences during the previous seven days. Ample space is devoted to *News Items* and *Correspondence* and to the weekly official list of changes in the *Army and Navy Medical Departments*. In typographical arrangement everything has been done to economize the time and to promote the comfort of its readers, and although THE NEWS contains more matter than any other weekly medical journal in this country, the subscription price remains at the very low sum of Five Dollars per annum.

The American Journal of the Medical Sciences.

A Quarterly, Published on the first days of January, April, July and October, each Number containing over 800 large Octavo Pages, fully illustrated.

Founded in 1820, THE AMERICAN JOURNAL can now look back on more than 63 years of faithful and honorable service to the profession, with full assurance of continuing usefulness. The great amount of space devoted to *Original Articles* enables it in each issue to present a large number of elaborate papers, embracing in scope all departments of medical science. The *Reviews* have always been noted for their impartiality and discernment, and the *Quarterly Summary of Improvements and Discoveries*, classified under appropriate heads, is highly valued as an accurate and convenient summary of medical advance. The subscription price of THE AMERICAN JOURNAL has never been raised during its long career; it is still furnished for Five Dollars per annum.

Together, THE AMERICAN JOURNAL and THE MEDICAL NEWS contain an equivalent of over 4000 octavo pages, in which duplication of matter is prevented by special management. They will be furnished together at a commutation rate of Nine Dollars per annum, in advance.

The safest mode of remittance is by Bank Check or Postal Money Order, drawn to the order of the undersigned; where these are not accessible, remittances may be made at our risk by forwarding in *Registered Letters*. Address,

HENRY C. LEA'S SON & CO.,

706 & 708 Sansom Street, Philadelphia.